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GNU C/C++ AND FORTRAN LANGUAGE INTEROPERABILITY WITH FUNCTION USAGE: PART II

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Detroit Arsenal
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GNU C/C++ AND FORTRAN LANGUAGE INTEROPERABILITY WITH FUNCTION USAGE: PART II

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This report is a continuation of Technical Report (TR) 22646 and documents GNU and Intel Fortran/C++ compiler options for interoperability between C/C++ and FORTRAN. The actions addressed are manipulation of Fortran COMMON BLOCKS with C++ Structures and the usage of multiple definitions.

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PART II

This report is a continuation of Technical Report (TR) 22646 and documents GNU and Intel Fortran/C++ compiler options for interoperability between C/C++ and FORTRAN. The actions addressed are manipulation of Fortran COMMON BLOCKS with C++ Structures and the usage of multiple definitions.

All examples were run on SUSE Linux Enterprise Server 11 (x86_64) using the GNU utilities as in TR 22646---with the addition of

- xild (GNU ld (GNU Binutils; SUSE Linux Enterprise 11) 2.20.0.20100122-0.7.9)
- ifort 10.1 20080312
- icc 10.1 20080312

References cited are [8] (from TR 22646) and [17] (new for TR 23321).

4.4 FORTRAN COMMON BLOCK MANIPULATION USING C++ STRUCTURES

This example shows how to call C++ from FORTRAN and the usage of the C++ structures to manipulate FORTRAN COMMON blocks (see [8]).

4.4.1 GNU

The GNU Fortran/C++ compiler is used here.

```
echo "---GNU---"
rm main.o
gfortran -m32 -c main.f  -lgfortran
rm cpps.o
gcc -m32 -c cpps.cpp -lstdc++
rm pstu.e
gfortran -m32 main.o cpps.o -o pstu.e  -lstdc++
pstu.e
```

cpps.cpp

```
#include <iostream>
#include <cstring>
using namespace std;

extern "C" {
   extern struct {
        double x;
        int a,b,c;
        char s10[10];
   } abc_;

   void cpps_() {
        cout << "cpps: begin" << endl;
        abc_.x = 78.9998;
        abc_.a = abc_.b*abc_.c;
        abc_.b = 101;
        abc_.c = -54;
        strncpy(abc_.s10,"CHANGE_ALL",10);
        cout << " x:" << abc_.x << endl;
        cout << " a,b,c:" << abc_.a << "," << abc_.b << "," << abc_.c << endl;
        cout << " s10:" << abc_.s10 << endl;
        cout << "cpps: end" << endl;
   }
}
```

main.f

```
   PROGRAM main
   DOUBLE PRECISION X
   INTEGER A,B,C
   CHARACTER*10 S10
   COMMON /ABC/X,A,B,C,S10
   print *,'main: begin'
   X = 55.39
   A = 1
   B = 2
   C = 5
   S10 = 'HOW_ARE_U?'
   print *,'X:',X
   print *,'A,B,C:',A,B,C
   print *,'S10:','[',S10,']'
   CALL cpps()
   print *,'X:',X
   print *,'A,B,C:',A,B,C
   print *,'S10:','[',S10,']'
   print *,'main: end'
   END
```

OUTPUT:

```
---GNU---
main: begin
 X:   55.389999389648438
 A,B,C:           1           2           5
 S10:[HOW_ARE_U?]
cpps: begin
 x:78.9998
 a,b,c:10,101,-54
 s10:CHANGE_ALL
cpps: end
 X:   78.999799999999993
 A,B,C:          10         101         -54
 S10:[CHANGE_ALL]
 main: end
```

4.4.2 INTEL

The Intel Fortran/C++ compiler is used here. The `cpps.cpp` and `main.f` files are the same as in Section 4.4.1.

```
#!/usr/bin/tcsh
# Intel Compiler
source /apps/intel/fc/10.1.015/bin/ifortvars.csh
source /apps/intel/cc/10.1.015/bin/iccvars.csh

echo "---INTEL---"
rm main.o
ifort -m32 -c main.f
rm cpps.o
icc -m32 -c cpps.cpp -L/usr/lib -lstdc++
rm pstu.e
ifort -m32 main.o cpps.o -o pstu.e -L/usr/lib -lstdc++
pstu.e
```

OUTPUT:

```
 ---INTEL---
  main: begin
  X:   55.3899993896484
  A,B,C:           1           2           5
  S10:[HOW_ARE_U?]
 cpps: begin
  x:78.9998
  a,b,c:10,101,-54
  s10:CHANGE_ALL
 cpps: end
  X:   78.9998000000000
  A,B,C:          10         101         -54
  S10:[CHANGE_ALL]
  main: end
```

The differences between the GNU and Intel floating point numbers should be noted.

4.5 MULTIPLE DEFINITIONS

This example shows how to use multiple definitions to modify already compiled object files. The `cpps.cpp` and `main.f` files are the same as in Section 4.4.1.

4.5.1 GNU

The GNU Fortran/C++ compiler is used here. Referencing [17], there are 3 file descriptors, stdin, stdout and stderr (std=standard). The number 1 'represents' stdout and 2 stderr. An example would be

```
cat file 2 >& 1
```

Proper output order when redirecting is maintained by setting

```
setenv GFORTRAN_UNBUFFERED_ALL Y
```

Using "`gfortran -help`" comma-separated options are passed to the linker as "`-Wl,<options>`". Using "`ld -help`" the linker option "`-z muldefs`" allows multiple defintions.

```
#!/usr/bin/tcsh
setenv GFORTRAN_UNBUFFERED_ALL Y
echo "---GNU---"

# make original
rm main.o
gfortran -m32 -c ../../struct/gnu/main.f  -lgfortran
rm cpps.o
gcc -m32 -c ../../struct/gnu/cpps.cpp -lstdc++
rm pstu.e
ld -V -m elf_i386 -r main.o cpps.o -o pstu.o
gfortran -m32 pstu.o -o pstu.e  -lstdc++
echo "---main with cpps"
pstu.e

# make update
rm main1.o
gfortran -m32 -c main1.f  -lgfortran
rm cpps1.o
gcc -m32 -c cpps1.cpp -lstdc++

# replace main with main1
echo "---replace main with main1"
gfortran -m32 main1.o pstu.o -o pstu1.e  -lstdc++
echo "---replace main with main1"
rm pstu1.e
gfortran -m32 main1.o pstu.o -o pstu1.e  -lstdc++ -Wl,-z,muldefs
pstu1.e

# replace cpps with cpps1
echo "---replace cpps with cpps1"
gfortran -m32 cpps1.o pstu.o -o pstu2.e  -lstdc++
echo "---replace cpps with cpps1"
rm pstu2.e
gfortran -m32 cpps1.o pstu.o -o pstu2.e  -lstdc++ -Wl,-z,muldefs
pstu2.e

# replace main and cpps
echo "---replace main/cpps with main1/cpps1"
gfortran -m32 main1.o cpps1.o pstu.o -o pstu3.e  -lstdc++
echo "---replace main/cpps with main1/cpps1"
rm pstu3.e
gfortran -m32 main1.o cpps1.o pstu.o -o pstu3.e  -lstdc++ -Wl,-z,muldefs
pstu3.e
```

cpps1.cpp

```
#include <iostream>
#include <cstring>
using namespace std;

extern "C" {
   extern struct {
        double x;
        int a,b,c;
        char s10[10];
   } abc_;

   void cpps_() {
        cout << "cpps1: begin" << endl;
        abc_.x = 90023.876;
        abc_.a = 23.97;
        abc_.b = 1.0004;
        abc_.c = -999.9;
        strncpy(abc_.s10,"ALLCHANGED",10);
        cout << " x:" << abc_.x << endl;
        cout << " a,b,c:" << abc_.a << "," << abc_.b << "," << abc_.c << endl;
        cout << " s10:" << abc_.s10 << endl;
        cout << "cpps1: end" << endl;
   }
}
```

main1.f

```
   PROGRAM main
   DOUBLE PRECISION X
   INTEGER A,B,C
   CHARACTER*10 S10
   COMMON /ABC/X,A,B,C,S10
   print *,'main1: begin'
   X = 888.2954
   A = -4.307
   B = 2.3571
   C = 67.9
   S10 = 'U_ARE_FINE'
   print *,'X:',X
   print *,'A,B,C:',A,B,C
   print *,'S10:','[',S10,']'
   CALL cpps()
   print *,'X:',X
   print *,'A,B,C:',A,B,C
   print *,'S10:','[',S10,']'
   print *,'main1: end'
   END
```

OUTPUT:

```
---GNU---
GNU ld (GNU Binutils; SUSE Linux Enterprise 11) 2.20.0.20100122-0.7.9
  Supported emulations:
   elf_x86_64
   elf_i386
   i386linux
   elf_l1om
---main with cpps
 main: begin
 X:   55.389999389648438
 A,B,C:           1           2           5
 S10:[HOW_ARE_U?]
cpps: begin
 x:78.9998
 a,b,c:10,101,-54
 s10:CHANGE_ALL
cpps: end
 X:   78.999799999999993
 A,B,C:          10         101         -54
 S10:[CHANGE_ALL]
 main: end
---replace main with main1
pstu.o: In function `MAIN__':
(.text+0x0): multiple definition of `MAIN__'
main1.o:main1.f:(.text+0x0): first defined here
collect2: ld returned 1 exit status
---replace main with main1
rm: cannot remove `pstu1.e': No such file or directory
 main1: begin
 X:   888.29541015625000
 A,B,C:          -4           2          67
 S10:[U_ARE_FINE]
cpps: begin
 x:78.9998
 a,b,c:134,101,-54
 s10:CHANGE_ALL
cpps: end
 X:   78.999799999999993
 A,B,C:         134         101         -54
 S10:[CHANGE_ALL]
 main1: end
---replace cpps with cpps1
pstu.o: In function `cpps_':
(.text+0x57c): multiple definition of `cpps_'
cpps1.o:cpps1.cpp:(.text+0x5c): first defined here
collect2: ld returned 1 exit status
---replace cpps with cpps1
rm: cannot remove `pstu2.e': No such file or directory
 main: begin
 X:   55.389999389648438
 A,B,C:           1           2           5
 S10:[HOW_ARE_U?]
cpps1: begin
 x:90023.9
 a,b,c:23,1,-999
 s10:ALLCHANGED
cpps1: end
 X:   90023.876000000004
 A,B,C:          23           1        -999
 S10:[ALLCHANGED]
 main: end
```

```
---replace main/cpps with main1/cpps1
pstu.o: In function `cpps_':
(.text+0x57c): multiple definition of `cpps_'
cpps1.o:cpps1.cpp:(.text+0x5c): first defined here
pstu.o: In function `MAIN__':
(.text+0x0): multiple definition of `MAIN__'
main1.o:main1.f:(.text+0x0): first defined here
collect2: ld returned 1 exit status
---replace main/cpps with main1/cpps1
rm: cannot remove `pstu3.e': No such file or directory
 main1: begin
 X:   888.29541015625000
 A,B,C:          -4           2          67
 S10:[U_ARE_FINE]
cpps1: begin
 x:90023.9
 a,b,c:23,1,-999
 s10:ALLCHANGED
cpps1: end
 X:   90023.876000000004
 A,B,C:          23           1        -999
 S10:[ALLCHANGED]
 main1: end
service0 328%
```

4.5.2 INTEL

The Intel Fortran/C++ compiler is used here. The files are the same as in Section 4.5.1. Using "`ifort -help`" comma-separated options are passed to the linker as "`-Wl,<o1>[,<o2>,...]`". Using "`xild -help`" the linker option "`-z muldefs`" allows multiple defintions.

```
#!/usr/bin/tcsh

# Intel Compiler
source /apps/intel/fc/10.1.015/bin/ifortvars.csh
source /apps/intel/cc/10.1.015/bin/iccvars.csh

echo "---INTEL---"

# make original
rm main.o
ifort -m32 -c ../../struct/intel/main.f
rm cpps.o
icc -m32 -c ../../struct/intel/cpps.cpp
rm pstu.e
xild -V -m elf_i386 -r main.o cpps.o -o pstu.o
ifort -m32 pstu.o -o pstu.e  -L/usr/lib -lstdc++
echo "---main with cpps"
pstu.e

# make update
rm main1.o
ifort -m32 -c main1.f
rm cpps1.o
icc -m32 -c cpps1.cpp

# replace main with main1
echo "---replace main with main1"
ifort -m32 main1.o pstu.o -o pstu1.e -L/usr/lib -lstdc++
echo "---replace main with main1"
rm pstu1.e
ifort -m32 main1.o pstu.o -o pstu1.e -L/usr/lib -lstdc++ -Wl,-z,muldefs
pstu1.e

# replace cpps with cpps1
```

```
echo "---replace cpps with cpps1"
ifort -m32 cpps1.o pstu.o -o pstu2.e -L/usr/lib -lstdc++
echo "---replace cpps with cpps1"
rm pstu2.e
ifort -m32 cpps1.o pstu.o -o pstu2.e -L/usr/lib -lstdc++ -Wl,-z,muldefs
pstu2.e

# replace main and cpps
echo "---replace main/cpps with main1/cpps1"
ifort -m32 main1.o cpps1.o pstu.o -o pstu3.e -L/usr/lib -lstdc++
echo "---replace main/cpps with main1/cpps1"
rm pstu3.e
ifort -m32 main1.o cpps1.o pstu.o -o pstu3.e -L/usr/lib -lstdc++ -Wl,-z,muldefs
pstu3.e
```

OUTPUT:

```
 ---INTEL---
 xild: warning empty_IPO_object_list: empty multi-file optimizations object list
 xild: executing 'ld'
 GNU ld (GNU Binutils; SUSE Linux Enterprise 11) 2.20.0.20100122-0.7.9
   Supported emulations:
    elf_x86_64
    elf_i386
    i386linux
    elf_l1om
 ---main with cpps
  main: begin
  X:   55.3899993896484
  A,B,C:           1           2           5
  S10:[HOW_ARE_U?]
 cpps: begin
  x:78.9998
  a,b,c:10,101,-54
  s10:CHANGE_ALL
 cpps: end
  X:   78.9998000000000
  A,B,C:          10         101         -54
  S10:[CHANGE_ALL]
  main: end
 ---replace main with main1
 pstu.o: In function `MAIN__':
 (.text+0x0): multiple definition of `MAIN__'
 main1.o:main1.f:(.text+0x0): first defined here
 ---replace main with main1
 rm: cannot remove `pstu1.e': No such file or directory
  main1: begin
  X:   888.295410156250
  A,B,C:          -4           2          67
  S10:[U_ARE_FINE]
 cpps: begin
  x:78.9998
  a,b,c:134,101,-54
  s10:CHANGE_ALL
 cpps: end
  X:   78.9998000000000
  A,B,C:         134         101         -54
  S10:[CHANGE_ALL]
  main1: end
```

```
---replace cpps with cpps1
pstu.o: In function `cpps_':
(.text+0x45a): multiple definition of `cpps_'
cpps1.o:cpps1.cpp:(.text+0x22): first defined here
---replace cpps with cpps1
rm: cannot remove `pstu2.e': No such file or directory
 main: begin
 X:   55.3899993896484
 A,B,C:           1           2           5
 S10:[HOW_ARE_U?]
cpps1: begin
 x:90023.9
 a,b,c:23,1,-999
 s10:ALLCHANGED
cpps1: end
 X:   90023.8760000000
 A,B,C:          23           1        -999
 S10:[ALLCHANGED]
 main: end
---replace main/cpps with main1/cpps1
pstu.o: In function `cpps_':
(.text+0x45a): multiple definition of `cpps_'
cpps1.o:cpps1.cpp:(.text+0x22): first defined here
pstu.o: In function `MAIN__':
(.text+0x0): multiple definition of `MAIN__'
main1.o:main1.f:(.text+0x0): first defined here
---replace main/cpps with main1/cpps1
rm: cannot remove `pstu3.e': No such file or directory
 main1: begin
 X:   888.295410156250
 A,B,C:          -4           2          67
 S10:[U_ARE_FINE]
cpps1: begin
 x:90023.9
 a,b,c:23,1,-999
 s10:ALLCHANGED
cpps1: end
 X:   90023.8760000000
 A,B,C:          23           1        -999
 S10:[ALLCHANGED]
 main1: end
```

REFERENCES

[8] http://www.yolinux.com/TUTORIALS/LinuxTutorialMixingFortranAndC.html

[17] http://tldp.org/HOWTO/Bash-Prog-Intro-HOWTO-3.html